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# Antimicrobial Resistance and the Social Sciences: A Narrative Review

**July 2022**

**Prepared by:**

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# Executive Summary

Antimicrobial resistance (AMR) has long been recognized as a significant threat to both national and global public health. Numerous strategies have been implemented to mitigate the risk of AMR, and certain interventions have been shown to reduce inappropriate antibiotic use and resistance rates. However, rates of certain resistant organisms continue to rise in Canada, resulting in increased risk of serious illness or death. Piecemeal interventions in particular settings and strategies that focus on education or knowledge alone are widely regarded as insufficient and unsustainable. Instead, AMR is understood to require a One Health approach, involving a societal, multi-sector response and holistic, integrative framing of social, biological, and ecological perspectives. The One Health framing has raised awareness on a wider set of factors contributing to AMR, including social and societal level factors. Social scientists have the suitable concepts, theories and methods to explore added possibilities for interventions. Over the past decade, greater attention has been paid to how social sciences research may contribute to our understanding of AMR. As such, published literature on AMR with a social sciences lens has increased dramatically in recent years.

The purpose of this narrative review is to explore how social sciences research may contribute to our understanding of AMR and antibiotic prescribing in human health and inform mitigation strategies. This review describes the extant social sciences literature, identifies emerging themes and proposes areas for further investigation. The literature search covered published and grey literature and was carried out in three stages, beginning with a broad, unstructured search of databases and websites. This was followed by refined keyword searches and concluded with searches of specific journals and references based on themes emerging from the broader searches. Effort was made to identify and include Canadian research content where available.

The review identified over 80 examples of social sciences research related to AMR, and three key theme areas were explored. Firstly, studies frequently identify an association between indicators of social and structural disadvantage (such as low income, lower education, overcrowded housing and others) and increased rates of AMR. Secondly, numerous published articles explore how antibiotics are prescribed and used, establishing that social, psychological, and behavioural factors intersect with decisions around antibiotic use. Finally, studies describe the successes and failures of numerous antimicrobial stewardship programs, exploring how contextual factors and interpersonal team dynamics must be understood when developing interventions aimed at mitigating AMR.

This review establishes that social, structural, behavioural, and cultural factors are linked to antibiotic use patterns and AMR. The relationship between higher rates of AMR and indicators of disadvantage suggests a need to include strategies aimed at addressing social and structural determinants of inequitable AMR outcomes. Numerous examples of Canadian research were found, but gaps remain in our understanding of AMR in Canada, particularly in rural and remote communities as well as in

racialized and other structurally disadvantaged populations. While antimicrobial stewardship interventions can be successful, program development should be informed by social sciences research on complex cultural meanings ascribed to antibiotics that affect health behaviors; the upstream and socially constructed drivers of prescribing behavior and antibiotic usage, particularly for populations disadvantaged by institutional racism and inequitable access to health services; and the social dynamics among healthcare teams and between prescribers and patients.

# Introduction

The invention of antibiotics in the early 20th century resulted in lasting, transformative changes in medicine, agriculture, and other sectors. Today, Canadians fill over 20 million antibiotic prescriptions each year, and approximately 1 million kilograms of medically important antibiotics are sold for animal use annually in Canada (1,2). While antibiotics have numerous practical applications, misuse and overuse of antibiotics can lead to antimicrobial resistance (AMR) (3). The World Health Organization recognizes AMR as one of the top 10 global public health threats facing humanity, citing rising resistance rates, threats to healthcare delivery and associated economic costs as areas of particular concern (4). In Canada, a panel of experts convened by the Council of Canadian Academies (CCA) estimated that annual national economic costs due to AMR could grow to $21 Billion CAD by 2050 if resistance rates rise from 26% to 40%, a scenario deemed likely (5). The CCA report suggests that over 5,000 Canadians die each year as a direct result of AMR and predicts that worsening resistance will disproportionally affect vulnerable populations. Vulnerable groups identified in the CCA report include people with a compromised immune system, higher exposure to infections, and recent antibiotic use or hospitalization. The authors also emphasize that elevated risk for resistant infections goes beyond clinical factors to include sociodemographic, behavioral and travel factors. The report also calls attention to inadequate consideration of equity in assessments of AMR consequences for Canadian society. Discrimination against those with resistant infections and restrictions on travel and migration are some examples of the potential social impacts that may arise from worsening AMR highlighted by the CCA report (5).

Given the significant medical, social, and economic risks posed by AMR, numerous strategies have been explored to prevent worsening resistance and protect human health, although interventions are largely concentrated in urban hospital settings with limited coordination at regional and provincial levels. In Canada, the *Pan-Canadian Framework for Action on Antimicrobial Resistance* aims at greater coordination and comprehensiveness nationally; the framework identifies surveillance, stewardship, research and innovation, and infection prevention and control as the key pillars for action to mitigate AMR (6). Aligning with global action plans on AMR, the Canadian government and key stakeholders apply a One Health lens to the AMR action plan, an approach that recognizes the interconnectedness of humans, animals and the environment and the need for upstream and coordinated action across sectors. The One Health approach in AMR research has explored a wide set of variables and called for more recognition that although antibiotic consumption is a major driver of the emergence and maintenance of AMR, the underlying drivers of AMR are multifactorial, resulting from a complex interplay between individual behaviours, social dynamics, economic factors and public policies, amongst others (7). One Health researchers have drawn attention to societal and ecological factors and to the influence that social norms at various levels have on the development of AMR, demonstrating the need for "convergent actions across the globe" as well as individual and local intervention (8). Thus, the One Health framing of AMR elevates the importance of some social and societal level factors which

social scientists have the appropriate concepts, theories and methods to explore for added insight into possible interventions. Consequently, the number of published papers on AMR and the social sciences has increased substantially over the past decade, from less than 50 publications per year between 2010 and 2014, to almost 200 publications in 2019 alone (9). Given the recent growth in this area of research, it is important to determine if social sciences literature can offer public health new insights into AMR prevention and mitigation in Canada.

## Objectives

The purpose of this narrative review is to explore published social sciences research relating to AMR in human health. The goal is to characterise the breadth of published literature and identify key themes or concepts arising from the review that may be relevant to AMR control strategies in Canada. Using themes that emerged from initial searches, focused searches of pertinent journals and databases were conducted to identify gaps in knowledge, as well as areas where further research or topic exploration may be of benefit to practitioners, researchers and policy makers, particularly those within public health and those responsible for AMR prevention and antibiotic stewardship programs .

## Methods

This narrative review (10) was conducted by the National Collaborating Centre for Infectious Diseases (NCCID) in Winnipeg, Canada, between June and September 2021. Ethics approval was not required as only published, publicly accessible materials were included. Initially, the scope of available social sciences publications on AMR was unknown., so a three-phased approach was used, refining and revising key questions as the search progressed.

The first phase of the review involved a series of clarifying and exploratory exercises. NCCID team members provided input on a list of key questions and topic areas that, if answered, could prove useful in future research and policy development. It was understood that not every question would be answered by the review; however, the exercise provided a starting point to begin searching the literature. Initial questions included whether Canada or other countries have used social sciences research to inform AMR mitigation strategies, whether frameworks have been created to organize an approach to AMR though the social sciences, and who the major contributors of social sciences research on AMR are, among others. It was decided at this stage to narrow the scope of the project to human health only as the focus. Visual mapping exercises were conducted to help develop a conceptual framework for the relationships between antibiotic use, infections, patients, and prescribers. This was

done prior to the first literature searches, allowing for further clarification of the key questions and goals of the review.

The second phase of this review involved a broad search of social sciences publications relating to AMR. This involved several unstructured Google and website searches of grey literature and searches in research databases, including Scopus, Embase, and ProQuest. The main search terms employed in the second phase search were ''AMR'', ''antimicrobial resistance'', and ''social science''. The website search included topical webpages focused on antimicrobial or antibiotic resistance on the Public Health Agency of Canada and the World Health Organization websites. The primary goals of these initial searches were to determine if literature on the topic was abundant or sparce, assess whether certain themes or commonalities could be derived from the most easily accessible publications, and begin compiling a list of articles for later evaluation.

The third phase of this review involved focused searches of specific journals and databases, using the theme areas derived from the initial literature searches to determine key search terms and to identify relevant articles for retrieval. The following search terms were used: "anti"- "microbial", "resistance", "soci*", "anthro*", "behavio*" and Canad* (either as a search term or as a filter). The third phase search employed the research databases Scopus and PubMed, as well as JSTOR, CINAHL, and Social Services Abstracts, which are databases with greater coverage of social sciences research literature. Figure 1 illustrates the scope of the literature search and provides examples of specific journals searched. Citations from relevant, high-yield articles were also searched to further explore specific themes and/or concepts. While this phase involved structured searches, it was not done with the rigour of a scoping review. The search was not intended to be exhaustive. Rather, the searches remained exploratory and iterative, allowing the flexibility needed to fulfill the objectives of a narrative review. The reviewed articles were compiled in a data abstraction table (Appendix A).

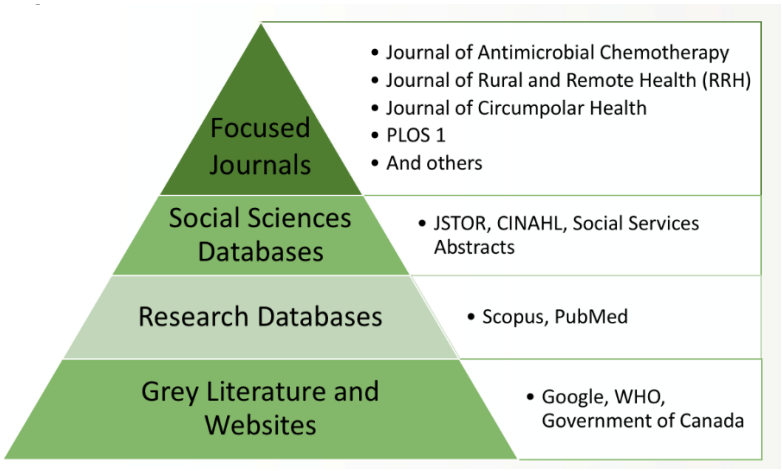


*Figure 1. Literature Search Scope and Refinement*

# Results

## Preliminary Search

Initial searches of databases and websites retrieved thousands of publications from around the world, revealing an extensive body of literature on AMR. Filtering the search to focus on social sciences publications also resulted in hundreds of publications. Most of the articles identified appear to have been published in the last decade, which is consistent with the review conducted by Lu et al. (9). Articles were from a mix of fields including anthropology, behavioural sciences, global health and general sociology. Recurrent themes included correlational research on socioeconomic factors and AMR, prescribing practices, cultural factors affecting the transaction of medications, and economic factors. Anthropological research most commonly addressed antimicrobial use and resistance in low and middle income countries, whereas social sciences studies looking at antibiotic stewardship programs more commonly related to higher income parts of the world. However, there was significant diversity in the types of studies and areas of focus in the articles initially examined.

## Refined Search

The refined database and journal searches focused on publications that may be relevant to a local or Canadian context and attempted to identify publications that would either benefit further antimicrobial stewardship advocacy work or identify areas warranting further study in Canada. During this phase, 76 publications were identified and included in the review. Of those, 72 were peer-reviewed publications and 4 were reports from governmental or non-governmental agencies. Among these publications, 14 were based on research conducted or reports prepared in Canada. Most of the articles were published in public health or biomedical journals, which is also consistent with the findings of Lu et al. (2020) (9). More than half of the reviewed studies occurred in the past 5 years (51 of 72 studies). Outside of Canada, most social sciences research articles (35 articles) reviewed were published in the United States, the United Kingdom or Australia. As noted, the literature search was not intended to be exhaustive, however numerous relevant publications were found and included in this review.

# Key Findings

The breadth of articles identified and reviewed reflects the interest in AMR-related research in many places and sectors.

Two noteworthy articles describing the range of social sciences research on AMR were identified early in the search and were used to identify other publications. The first, a protocol paper by Vedadhir et al. published in 2020, describes the protocol for a scoping review on social sciences literature on AMR (11). The authors' proposed search strategy provided useful database and search term suggestions for this review. The second article of note was the previously-mentioned review by Lu et al. (also from 2020), which provided a summary of the extent of social sciences publications on AMR over the past decade (9).

Studies with anthropological, sociological or behavioural methodologies provide important contextual data on the potential drivers of AMR in different settings. While reviewed articles often incorporated several thematic elements, the preponderance of social sciences articles addressed one of three broad theme areas: 1) *AMR and Social Determinants of Health, 2) AMR and Use of Antibiotics, and 3) AMR and Stewardship Interventions*.

## 1) AMR and Social Determinants of Health

Several articles reviewed identified or recognized a link between AMR and health equity, that is, pertaining to the social and structural determinants of health.

Research with an anthropological focus may provide important contextual data on the potential drivers of AMR. For example, Collignon et al. conducted a macro-level analysis of the effect of anthropological and socioeconomic factors on two global AMR indices (E.coli resistance and aggregate resistance[1]) for 103 and 73 countries, respectively, over a 6 year period (7). The authors' multivariate analysis found that, at the global level, better infrastructure (e.g. improved sanitation and potable water) and better governance (e.g. less corruption in public administration) were associated with lower AMR indices, and

[1] The two indices were: 1. *Escherichia coli* resistance—the global average prevalence of *E coli* bacteria that were resistant to third-generation cephalosporins and fluoroquinolones, and 2. aggregate resistance—the combined average prevalence of *E coli* and *Klebsiella* spp. resistant to third-generation cephalosporins, fluoroquinolones, and carbapenems, and meticillin-resistant *Staphylococcus aureus*.

their univariate analysis found lower AMR indices in regions with greater public healthcare spending, better education, and higher antibiotic consumption. Factors that create conditions that facilitate the spread of resistant organisms, like overcrowding and poor sanitation, were thought to partly explain the surprisingly poor association between AMR and consumption levels (7,12). The authors suggest that simply reducing antibiotic consumption is not the solution to AMR globally and urge greater consideration of how well sanitary, regulatory, and governing systems are functioning to control the spread of both sensitive and resistant microbes.

Disparities in AMR rates between lower and higher-income countries may also be explained by public policies and regulations. For example, a review by Majumder et al. explored research on global antibiotic stewardship approaches using the One Health model (13). The authors invoked the WHO's Global Action Plan on AMR as the ideal for national action plans, while also acknowledging the inherent challenges involved with diagnosing and treating infectious diseases and important differences in contexts which must factor into antibiotic stewardship strategies. The authors note that because many middle and lower-income countries have relatively few restrictions on the purchase and use of antibiotics, inappropriate self-diagnosis and unrestricted antibiotic use may be a driver of AMR in many parts of the world. Research by Saleh et al. in Jordan corroborates this hypothesis, with pharmacists identifying the lack of enforcement of prescription-only access to antibiotics and pressure from patients to receive the medication of their choice as factors making antimicrobial stewardship challenging (14). While regulatory or policy problems are readily perceived as a barrier to antibiotic stewardship in low-to-middle income countries, this qualitative research provides insights on several social, political and economic factors that also inhibit progress in the control of AMR, including socioeconomic factors that limit investment in professional training, the influence pharmacy owners exact on pharmacists, and the low socioeconomic status of the population, which affects affordability of physician services and prescription oversight in Jordan (14).

Research from Canada provides further evidence that social and structural disadvantages directly contribute to AMR. Two risk-factor analyses by Glass et al. attempted to identify the predictors of macrolide and fluoroquinolone use, respectively (15,16). Macrolide use was found to be greater in regions with higher populations of low-income individuals, lower education levels and higher levels of unemployment (14). However, fluoroquinolone use did not follow the same pattern, which is likely due to the relatively higher cost of fluoroquinolones compared to macrolides (15). For both antibiotic classes, greater prescribing was seen in areas with fewer physicians per capita, which is consistent with the observation by Marra et al. that higher patient loads are associated with higher antibiotic prescribing rates (17). Another study in the Province of Manitoba identified lower rates of inappropriate antibiotic use in children living in higher-income families (18). While the authors considered that parents in higher-income situations may be better educated or informed about antibiotic use, they also postulated that it may be easier for parents in higher-income households to take time off work when their child is ill, or they may have more flexible employment, making it easier to take a child back to a physician's office if needed (18).

Geographical setting and associated socio-structural factors have also been shown to correlate with antibiotic use. Factors such as limited access to clean water and poor sanitation are associated with higher rates of AMR, and are often coupled with other structural disadvantages including poor nutrition and limited education (19). In Canada, people living in communities in the Arctic have higher average antibiotic dispensing rates compared to those living in large urban centres like Edmonton (20). A narrative review of international studies of antimicrobial use and stewardship in rural primary care (n=51) found increasing rurality of practice was often associated with disproportionally higher rates of inappropriate prescribing compared to those in metropolitan areas. The studies reviewed in the paper identified a range of prescriber, health services and population risk factors for inappropriate prescribing in rural settings, including reduced access to medical care and diagnostics, heavy patient loads for doctors, dispersed patient populations with high disease burden, and insufficient access to follow-up, among other factors (21). The authors highlighted gaps in research on rural antimicrobial stewardship programs, limited study of stewardship outcomes in Indigenous communities, as well as insufficient differentiation between rural, remote and Indigenous community settings. A systematic review of Methicillin-resistant *Staphylococcus aureus* (MRSA) infections in Canada clearly demonstrated how people living in rural, remote and Indigenous communities are significantly more likely to develop MRSA infections (22). MRSA infections in particular are more likely to propagate in environments with overcrowding, lack of running water and other conditions that do not support adequate hygiene. The authors point to needed investments in these communities, particularly for additional surveillance, infection control measures, enhanced anti-microbial stewardship, as well as community education programs (22). The research is indicative of the need to examine structural determinants that put Indigenous peoples at greater risk of AMR or higher use of antibiotics.

## 2) AMR and Antibiotic Use

Studies have demonstrated how inappropriate use of antibiotics can result in AMR, even at the individual level (23). However, social sciences research advances this understanding by exploring the factors contributing to the use of antibiotics by individuals, groups or populations. As Merrett et al. suggest, there is a divergence between the perceived and actual value of antibiotics, which reflects the relationship between antibiotic use and social norms, perceived meanings and, particularly for low income countries, economic markets (24).

### *Cultural Factors*

In consideration of higher-income countries, research has explored numerous factors to identify societal level determinants of antibiotic use and account for national differences in usage. For example, a modelling study compared antibiotic use in 19 European countries against numerous potential

determinants of antibiotic use. The study found higher antibiotic use in countries with older populations, higher healthcare expenditure, greater feelings of distrust of others, as well as environmental factors, such as higher humidity (included as a proxy measure for disease transmissibility) (25). Another study that compared European countries for antibiotic use found that most of the variation in antibiotic use between countries could be explained by cultural differences, socioeconomic factors and dominant national personality characteristics (26).

Etkin suggests that medicines are "socially transacted throughout the therapeutic process," as observed in various cultures and societies around the world (27). While pharmaceuticals are generally marketed for a single, primary intended use or effect in western societies, most medications have numerous other, "side" effects or unintended effects as well. A medication may be used by a person for reasons other than its "intended" purpose, influenced by cultural factors and local or regional beliefs more than by medical science. Etkin suggests that knowledge of people's culturally constructed understanding and expectations of therapies can help inform guidance on 'rational' or appropriate use, more so than biomedical approaches that seek to homogenize the interpretation process. The transactional, relational underpinnings of antibiotic prescribing have also been described in a study conducted in communities along the Mexico-United States border. A cultural consensus survey of pharmacies in a Mexican border town demonstrated a relationship between greater public health knowledge (i.e. on "safe" antibiotic use) and lower rates of antibiotic purchasing (28). However, the cultural context used between patients (including Mexican clients and US medical tourists) and pharmacists generally had a stronger economic, transactional focus rather than a medical one, reflecting beliefs shared by pharmacists and clients on the patients' right to purchase medications over the counter without the need for information on medical compliance or medical efficacy. Furthermore, the authors suggest that there is a significant healing power ascribed to antibiotic medicines, and potential individual-level harms are often minimized or ignored in these interactions (28).

Another relevant cultural factor addressed in the research literature is the concept of scientific relativity, or the idea that scientific information is re-evaluated by individuals and applied or disregarded based on the individual's beliefs or opinions. This concept is explored by Carrion in interviews with mothers in the United States (29). Focusing on perceptions about vaccines, those interviewed often defended scientific approaches, yet paradoxically put greater value on personal experience and maternal instinct when making decisions for their children. In a research brief reviewing the many ways society and culture influence perspectives on medicine, and antibiotics in particular, Wood comments on the history of expanding scope of medicine, as a facet of power-seeking on the part of some clinicians, but also due to expectations in some societies (30) . This finding and the recognition of how postmodern perspectives influence medical decision-making in high-income countries may be relevant when considering how antibiotics are used. Western countries' trends of increasing medicalization – normalizing interventions for matters not previously considered to be medical issues --must also be explored as a potential cultural driver of antibiotic misuse (30).

Cultural differences in the interpretation of certain diseases and medicines are observable amongst different ethnic groups in Canada. Research by Morgan et al. in British Columbia found differences in prescription drug use between White (i.e. generally European) and Asian residents, which varied depending on the class of medication studied (31). Comparing groups for antibiotic use, South Asian men were more likely to fill a prescription than White men, though the reason for this difference was not apparent. Although these variations in medication use may have a cultural basis, the effect may also be mediated by other variables related to both antibiotic use and ethnicity. While comparison of global patterns and major culture groups may help generate hypotheses or general policy directions, research focused on more specific social and systemic influences on antibiotic use could have greater relevance for studies of AMR and interventions to improve antibiotic use.

### *Prescriber and Patient Factors*

In Canada and other higher income countries, antibiotics for human use must be prescribed, usually by a physician, although dentists, midwives, and nurse practitioners are also commonly licensed to prescribe antibiotics and other antimicrobials. As a result, antibiotic use is necessarily linked with prescriber-level factors. Family physicians are one of the largest groups of outpatient antibiotic prescribers, and on average prescribe 54 antibiotics per 1,000 patient encounters in Canada (32). Prescriber behaviours have been shown to vary substantially, and certain prescriber characteristics are correlated with antibiotic use. A cohort study of family physicians across Ontario, Canada demonstrated that variability amongst prescribers was a more important predictor of antibiotic prescribing than variability of patient characteristics, with the "odds of receiving an antibiotic [varying] by 1.7-fold for the same patient simply by virtue of encountering two different physicians" (32). Variation was also seen across regions. Among primary care physicians in Quebec, higher rates of antibiotic prescribing were seen amongst physicians with higher-volume practices, those who completed their medical training outside of Canada, and those who have been in practice for longer (33). Gidengil et al. further explored the prescriber-level drivers of inappropriate antibiotic prescribing (i.e. prescribing for non-antibiotic-appropriate diagnoses, failure to prescribe for an antibiotic-appropriate diagnosis, or prescribing a non-guideline-concordant antibiotic), and found that physicians who felt more rushed in their clinical practices had higher antibiotic prescribing rates (34). Furthermore, physicians who felt that patient demand was not a problem in their practice were more likely to prescribe antibiotics incorrectly.

The interaction between patients and prescribers during a clinical encounter may also influence antibiotic use. While physicians likely consider prescription of antibiotics to be a medical decision, research suggests that it is also a social transaction. For instance, a qualitative study in Sweden conducted focus groups with general practitioners to explore antibiotic prescribing behaviours (35). Themes arising from the research illustrated how the decision to prescribe an antibiotic is initially influenced by whether the expectations of the patient and provider are perceived as aligned or in conflict, which resolves through collaboration or negotiation in either agreement, compromise or

disagreement. Decision-making processes were not only influenced by factors connected to the general practitioner (e.g. clinical skills, self-efficacy) but also relating to the physician-patient relationship (e.g. mutual trust, continuity and familiarity), and the setting (e.g., professionalism), including the practice culture (how the work (physician visits) is organized). The findings indicate that the decision-making process arises from interactions between individual, social, and systems factors; thus, medical knowledge is only one aspect of what determines whether an antibiotic will be prescribed in any given patient encounter (35) . Research by Avorn and Solomon provides insights into the values and beliefs that are implicit in what are culturally defined therapeutic interactions between patients and prescribers, observing that if an antibiotic is prescribed, it effectively ends the patient-prescriber encounter, defines the patient as being "sick" and in need of treatment, and provides a (perceived) answer to the patient's presenting concern (36). Awareness for these cultural dimensions of therapeutic encounters, that is, the normative roles, accrued meaning and motivations that favour particular conclusions about whether antibiotics should or will be prescribed, provides insights into how both prescribers and patients are influenced towards antibiotic use.

The practice of medicine in many high-income countries has gained awareness for an entrenched paternalistic ideology and has improved practices, for example, by increasing emphasis on patient autonomy and shared decision-making. Qualitative research exploring power dynamics in primary care through interviews with patients with acute lower respiratory tract infections in Spain found that the patients generally preferred to avoid using antibiotics; however, when they felt that they were too unwell to manage their symptoms alone, they tended to seek a "fast and definitive" solution to their illness (37). The study found that patients acknowledged that their physician was the medical expert, but also felt that they were experts regarding their own bodies. Unfortunately, inaccurate perceptions and expectations of a prescription from either the patient or the provider can result in antibiotic over-prescribing. Cockburn and Pit surveyed patients (n=756) and general practitioners (n=56) in Australia, finding that patients were three times more likely to receive prescription if they entered a clinical encounter wanting or expecting one (38). However, a prescriber's perception that their patient wanted medication was an even stronger influence, with the patient being 10 times more likely to receive a prescription once that perception is formed. The authors also noted that prescribers were more likely to ascribe an expectation of prescription to women than men (50.8% attributed expectation to females, 39.3% to males), despite there being no difference in patient reported expectations by sex, suggesting a gender bias in physicians' perceptions of female patients' acceptance of medical therapy.

## 3) AMR and Stewardship Interventions

Antibiotic stewardship is one of the four pillars of the *Pan-Canadian Framework for Action on AMR*, and stewardship interventions are a common part of many AMR mitigation strategies (6). While there is a good theoretical basis to assume that reducing inappropriate antibiotic use should result in decreased AMR, evidence on the effectiveness of stewardship interventions in real-world settings is mixed. For example, one review demonstrated that antibiotic stewardship programs are effective at reducing

resistant Clostridium difficile infections (39). However, a systematic review by Bertollo et al. looking broadly at antimicrobial stewardship interventions in hospitals highlighted the substantial variability between published studies, and was unable to draw any conclusion as to whether stewardship interventions were effective at reducing AMR in these settings (40). Some of this variability in study results may be due to the difficulty of constructing rigorous experimental studies in real-world settings. Academic and clinical specialists have acknowledged this gap, highlighting the need for increased research on the barriers and facilitators to implementing stewardship programs (41). Consequently, social sciences research may offer important perspectives on the broader social, systemic and structural factors that contribute to variability stewardship interventions in various settings.

### *Hospital Settings*

Between 2009 and 2016, overall antibiotic use per patient in Canadian hospitals declined by 12%, suggesting that meaningful changes have occurred in prescribing patterns (42). Nevertheless, according to Yu et al., antibiotics are still regularly overused or misused within hospitals (43). Social sciences research illustrates how inter-professional team dynamics and workplace cultures affect hospital prescribing behaviours. An in-depth anthropological study of antibiotic prescribing at a large hospital in the United States demonstrated how decision-making around antibiotic use is more of a social, collective practice as opposed to an individual one (44). Rynkiewich conducted an ethnographic case study that included over 500 hours of direct observation of hospital medical teams (44). The author identified a reductionist approach to inpatient stewardship programs that tends to focus on "correcting" individual-level behaviours rather than addressing systemic factors leading to inappropriate antibiotic use. The study found that, while most people in the clinical environment believed that they had control over their prescribing choices, antibiotic prescribing was observed to be a dynamic process involving many members of the clinical team (44). A modelling study conducted by Bettinger et al. found that antibiotic prescribing decisions were made with consideration for short and long-term perceived benefits or harms (e.g. penalties) to the providers, which varied considerably depending on the person or group (45). A systematic review of hospital antibiotic prescribing behaviors identified prescribers' fears of adverse outcomes, tolerance of uncertainty, hierarchies and social team dynamics as key determinants of how antibiotics are prescribed in hospitals (46). Similarly, in a study of compliance with stewardship policy, hospital-based prescribers were found to be more likely to identify hierarchies as barriers while stewardship committees report autonomy as a key reason for non-compliance with guidelines (47). While research suggests that some prescribers intentionally circumvent stewardship controls (i.e. "stealth dosing") (48), social dynamics in clinical teams are likely more significant drivers of prescribing behaviors.

Stewardship interventions are also context-dependent, and the same intervention may yield different outcomes in differing environments—contexts which social sciences research can help to clarify. A study of two intensive care units (ICUs) in Toronto, Canada demonstrated that a stewardship intervention (specifically, "audit and feedback") was effective at reducing antibiotic prescribing in one

ICU but not the other (49). While part of this difference may have been due to different patient populations, Taggart et al. acknowledged that the units had "…different leadership, cultures, educational structures and decision-making processes." Another study looking at antibiotic use across 129 hospitals in Ontario found substantial inter-facility variability, even when accounting for patient and hospital characteristics (50). The authors suggest that much of the discrepancy likely represents modifiable differences in local antibiotic prescribing practices, policy and culture.

### *Community Settings*

The social dynamics of antibiotic prescribing also influence stewardship interventions outside of hospitals. More than 60% of antibiotics in Canada for human use are prescribed by general practitioners and family physicians (51). Research cited in a commentary by Mehrotra and Linder (52) suggests that community-level interventions can be effective at reducing inappropriate antibiotic use, but effectiveness is dependent on the type of intervention. For instance, a common preventive approach to AMR is educating providers on antibiotic (mis)use, along with providing clinical guidelines. However, research suggests that most primary care providers have a good understanding of AMR, and that use of guidelines is not necessarily associated with antibiotic prescribing practices. The authors comment that educational approaches fall short because "the overuse of antibiotics is not a knowledge problem or a diagnostic problem; it is largely a psychological problem". That is, reasons for prescribing are often emotionally driven, such as feelings of wanting to appear capable, to "just be safe" in relation to rare complications, to cope with uncertainty, or to manage the perceived impressions of patients. Though acknowledging the value of continued education, the authors also recommend greater use of social psychology and behaviour science strategies, such as peer comparison and publicly visible justification for prescription of antibiotics (52). When educational interventions are used, successful stewardship strategies in community settings incorporate a more global, system level approach. A large-scale, multi-pronged stewardship program in the Province of Quebec strategically implemented and advertised antibiotic prescribing guidelines from 2003 to 2007, resulting in a significant decline in antibiotic use in the province compared with the rest of Canada during the same period (53). Importantly, this intervention went beyond simply creating and disseminating clinical guidelines. Instead, guidelines were developed to be user-friendly and visually appealing, and substantial effort was made to consult and engage professional organizations, experts, universities, and pharmaceutical companies.

Rural and remote settings pose different challenges for implementing and sustaining antimicrobial stewardship programs. In addition to the significant influence of social inequities and structural disadvantages on the health status of rural and remote residents, developing antimicrobial stewardship programs in remote settings is often considered challenging due to a lack of available specialists to monitor the program. However, a review of research literature by Bishop et al. has shown that stewardship programs can be successfully implemented when managed by non-specialists, including general practitioners, pharmacists and others (54). These models may be relevant to remote areas of

Canada where the availability of infectious diseases specialists is limited. As described in a narrative review by Yau et al., AMR in rural communities is higher than in larger urban centres, but research has demonstrated that stewardship programs can still be effective in these settings (21). The review also refers to some ongoing evaluation of collaborative approaches to stewardship involving prescribers and community pharmacists.

The research literature also describes AMR stewardship strategies used in primary care settings. Research on behavioural interventions suggests that 'peer comparison' (telling prescribers how their antibiotic prescribing behaviours compare with that of their peers) and 'accountable justification' (requiring prescribers to type in a reason for prescribing an antibiotic into the electronic patient record) are more effective than educational interventions such as providing the prescriber with alternative treatment options (55).

Another strategy for preventing inappropriate use of antibiotics is called 'watchful waiting'. This involves educating patients, or parents and caregivers if the patient is a child, to monitor their symptoms closely and use antibiotics only if their symptoms worsen or new signs of a bacterial infection develop. Through an online survey, Kim et al. explored how parents felt about the watchful waiting approach compared to immediately receiving an antibiotic prescription (56). Parents who had a negative emotional response to a watchful waiting recommendation were significantly less likely to adhere to the intervention. The authors found that this response was primarily driven by false beliefs about antibiotic effectiveness, suggesting that health education for caregivers and communication training for providers to help manage caregiver emotions may be necessary adjunctive steps to this intervention.

Educational interventions are also cornerstones of many AMR prevention activities; however, the use and effectiveness of educational methods varies. An attempt to implement an AMR mitigation strategy in remote Thai villages using materials developed by the WHO highlights how antibiotic use is mediated by social and cultural factors. In some communities, messaging around the use of antibiotics was confused by the fact that many people did not understand what an 'antibiotic' was, which led to conjecture and the spread of misinformation (57). Some people interpreted the messaging as a sign that there may be a shortage of antibiotic medications in the near future, prompting an increase in purchasing of antibiotics. Other medicine vendors became fearful of penalties for selling medications and began limiting access to a wide variety of medicines, not just antibiotics (57).

Behavioural sciences research has been applied in analyses of the general public's knowledge and perceptions about AMR to inform the design of messaging to help reduce antibiotic overuse. For example, a US-based study questioned the public (n=1014) to better understand how people viewed their role in AMR and its solution. The authors found that people were less likely to recognize either

their responsibility for AMR or their role in solving it, believing instead that the responsibility for the problem and solution belonged to pharmaceutical companies, scientists and healthcare providers (58). Patient knowledge of AMR has also been found to be quite variable, and individuals tend to minimize their perceived role in contributing to AMR (59). This attribution effectively avoids consideration of the patient-prescriber interaction, potentially hampering AMR mitigation efforts. To counter this, Zhou et al. has applied strategies using the Risk Information Seeking and Processing (RISP) model, with RISP-informed video interventions demonstrating efficacy in increasing awareness of AMR and decreasing positive affect toward antibiotics in general (60).

## Discussion

This narrative review identified numerous examples of how social sciences research provides insights into the drivers of AMR. Structural and social determinants of health, socially situated antibiotic prescribing behaviours, culturally based knowledge and beliefs that influence antibiotic use, and contextual factors that contribute to successes and pitfalls of stewardship programs are frequently discussed in published articles that apply social sciences concepts, theories and methods.

One of the important findings of this review is the connection between structural and social inequities and increased rates of AMR. Several articles found that factors such as lower income, crowded living spaces, and poor sanitation were associated with both antibiotic misuse and AMR. While the fundamental drivers of AMR are multi-faceted, inequity and structural determinants may create environments where resistant organisms are more likely to propagate. It is also plausible that those who live in communities disadvantaged by ongoing systemic and structural factors endure the compounding effect of also having poorer access to healthcare services and may encounter racism and discrimination when they seek health services. This is of particular importance in the Canadian context where literature suggests that AMR is more likely to occur amongst individuals living in Indigenous communities.

However, there appears to be a gap in the literature as to whether interventions focused on addressing social and structural disadvantages are effective in preventing or reducing disparities in AMR. Given the strong relationship between AMR and factors such as poor sanitation, there may be a need in the Canadian setting to develop and study community-level AMR prevention strategies that include mechanisms for assessing and rectifying social disparities. While the *Pan-Canadian Framework on AMR* does mention the need to reduce inequalities in delivering infection prevention and control programs, the core pillars of action fail to characterize the need for greater action on specific social determinants of health. (6) Public Health experts have traditionally engaged in advocacy and action to reduce social inequities and should be mindful of the association between inequities and worsening AMR.

This review identified numerous articles describing the complex social interface between healthcare providers and patients. From this research, it is apparent that both the patient and prescriber bring their own ideas, biases, cultures, and experiences into the clinical encounter. The magnitude of these factors is likely larger than prescribers or patients realize, meaning that clinical decisions as to whether an antibiotic should be prescribed occur within a highly dynamic social transaction. Importantly, prescribers are often biased in favour of prescribing antibiotics when they believe their patient wants one. For prescribers, this suggests that further awareness of one's own biases may be a relevant part of clinical training. Prescribers may also need to be armed with more effective tools to manage antibiotic prescribing conversations. Since it appears that there is generally not a knowledge gap between those who prescribe appropriately and those who do not, continuing to rely on education-focused interventions for prescribers may not be effective.

Physicians who have heavier patient loads or spend less time with their patients are more likely to prescribe antibiotics inappropriately. However, reducing patient volumes may not be feasible, particularly in low-resource environments where there are relatively few physicians caring for a population. Studies have corroborated this, noting that antibiotics are more likely to be prescribed when there is a low ratio of physicians per capita (17). Further examination of healthcare resources may be beneficial, particularly in rural and remote communities, as solutions aimed at preventing the overburdening of healthcare providers may also have an impact on AMR. However, data is limited on how such strategies could be applied within the Canadian context.

Social sciences research on AMR has occurred within both hospital (inpatient) settings and within the community. Many of the factors influencing antibiotic use are common between both; however, the interpersonal clinical team dynamic is a more pronounced consideration in hospitals. While clinicians often feel that they have sole discretion over whether they prescribe an antibiotic, often these decisions occur through discussion, negotiation, and at times are influenced by hierarchies within the workplace culture. This may in-part be why many stewardship programs are only partially effective, and different strategies should be explored. For example, Warreman et al. suggested that each determinant of antibiotic prescribing in hospitals could potentially be addressed in a specific, intentional way (46). In facilities where reputational risk significantly impacts prescribing behaviour, for instance, interventions focused on promoting a positive safety culture may be indicated. Likewise, teams that are driven to over-prescribe antibiotics due to fear or intolerance of uncertainty may benefit from structured training and guidance on how to overcome these barriers. By helping hospitals and teams understand the dynamic of their own prescribing behaviours, it is possible that more effective stewardship interventions can be applied.

Stewardship interventions in community settings may be similar, but should reflect local contexts. Interventions have been described that assess antibiotic prescribing or use behaviours, and then develop stewardship programs that are tailored to specific settings. One potential model is called

"Preserving Antibiotics through Safe Stewardship (PASS). This research program in the United Kingdom aims to evaluate antibiotic use in multiple settings, investigating the factors that influence prescribing and characterizing the gaps and facilitators in order to develop effective stewardship programs (61). Another research proposal (GPPAS Study) in Australia aims to systematically evaluate the relationships and collaboration between general practitioners and community pharmacists, purposefully exploring attitudes around antimicrobial stewardship and barriers and facilitators for implementation (62). Utilization-focused program development, implementation and evaluation may therefore be of benefit. Finally, the Values and Principles tool has been developed to support stakeholders when they attempt to engage with community members to tackle complex issues like AMR (63). Key values include clarity, creativity, evidence-led, equity, interdisciplinarity, sustainability and flexibility, and use of this tool may assist in developing collaborative relationships when developing AMR prevention strategies.

Unlike most other medicines, antibiotics used by individual patients can have population-level consequences (24). For this reason, public health practitioners have a critical role to play in addressing AMR. Public health has already contributed through actions such as research and surveillance. However, public health also has relevant expertise in the area of health promotion that could be of benefit. Social science research on AMR informs us of the social, behavioural, environmental and equity factors that contribute to worsening AMR and inequitable burden of its consequences; however, generating awareness and willingness to change behaviours may be challenging. Public health experts have the skills and resources to meaningfully contribute to the AMR discussion, including the development of messaging and materials that target prescribers. Additionally, the links between AMR, social inequities and community specific drivers that may reflect colonial policies should be explored further by public health practitioners, many of whom already work to address some of these inequities in their communities. There may also be value in further public health evaluation to determine whether targeted strategies to reduce inequities may in turn prevent AMR.

This narrative review has several important limitations. The literature search was not conducted in a systematic fashion, nor with the rigor required of a scoping review. While this allowed for the identification of a broad range of relevant publications, it is possible that some related articles were missed. Later phases of the literature search focused on specific theme areas, including prescriber-patient relationships and social determinants. It is known that social sciences research contributes to AMR beyond these focused areas, and further exploration of extant literature may be required. Later searches also focused, where possible, on Canadian data. While this was important for the purpose of this review, it also means that relevant studies in other parts of the world may have been missed. This review focuses on AMR and antibiotic use in humans. It is known that animal and agricultural use of antibiotics is a significant contributor to AMR, and while beyond the scope of this review, further exploration of social science research relating to drivers of AMR and interventions relevant to these sectors may be beneficial. Most publications were identified in biomedical journals rather than social sciences journals, which may reflect the intended audience of this research. Finally, many of the studies

describe population-level data, sometimes comparing one country against another. While this paints a picture of the factors relating to AMR and may be useful for generating hypotheses, caution must be made when drawing specific conclusions from these relationships.

## Conclusion

AMR is a known threat to the health of Canadians and people around the world. While there is an established breadth of current and historical microbiological research examining AMR, social sciences research on AMR has grown substantially over the last decade. As this review has identified, the social sciences can provide a greater level of insight into why certain prescribing behaviours occur, why some stewardship programs work and others fail, and how social inequities are intrinsically linked with worsening AMR. This research informs our understanding of AMR and offers potential avenues for prevention strategies.

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